



DoD Executive Agent

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Assistant Secretary
of the Army
(Installations and
Environment)

Photovoltaic (PV) Systems Comparison at Fort Hood

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Presentation Overview

- Project Drivers
- Photovoltaic (PV) Selection
- PV System Design
- Installation
- Demonstration

OBJECTIVE: Help the Department of Defense (DoD) build cost-effective, energy-efficient buildings. As a step towards achieving this, the National Defense Center for Energy and Environment (NDCEE) is assisting with sustainable design, evaluation of renewable energy systems, and innovative construction techniques for new buildings.

Project Drivers

- Executive Order (EO) 13423, Energy Policy Act of 2005, and Army policy require more energy-efficient/less polluting buildings
- Energy efficiency leads to reduced electricity use and costs, increased energy security, supply stability, reduced greenhouse gases, and improved living environment
- Work is transferable across all Services and into the private sector

NDCEE Demonstration

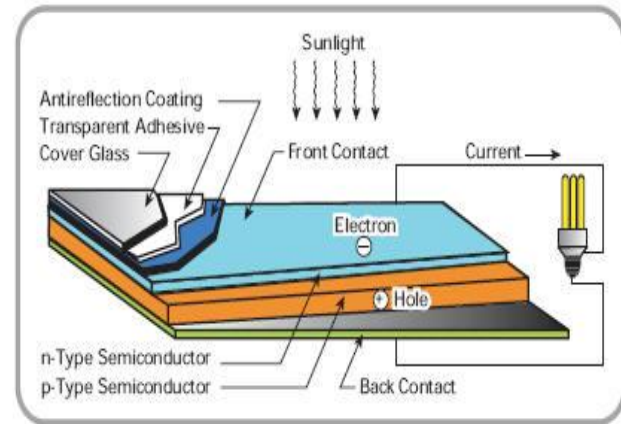
- Demo Objectives
 - Evaluate the performance and cost-effectiveness of PV and wind turbine technologies in producing energy for an administrative building
 - Compare the performance between two different PV technologies: thin film and crystalline PV panels
- Demo Team
 - NDCEE – Project Manager/technical lead
 - Fort Hood Directorate of Public Works (DPW) Environmental – building owner
 - Texas Solar Power – system designer/installer
 - Johnson Controls – metering designer/installer

Site Evaluation

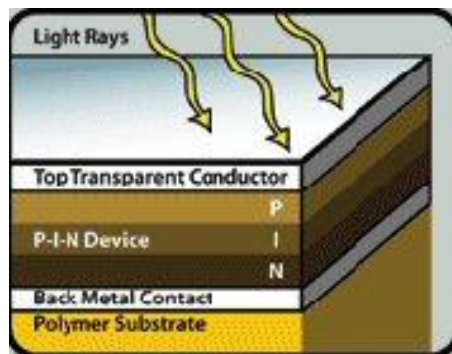
- Solar
 - National Renewable Energy Lab's (NREL's) PVWatt
 - Annual averages: 5.35 kWh/m²/day; 6,812 kWh
 - Decision: Demo 5 kilowatts (kW) PV system for demo
- Wind
 - Publically available wind data: 8-12 miles per hour (mph)
 - Local air field data: 3.7-7.5 mph
 - Decision: Collect wind data using a small weather station or conduct wind analysis

PV Technology

- Monocrystalline silicon¹



- Thin film²



1 “About Solar,” DBK Corporation, <http://www.dbksolar.com/About%20Solar.htm> from Subtask 047: Toledo Air National Guard Renewable Energy Demonstration

2 http://www.nrel.gov/learning/re_photovoltaics.html; (accessed 7/15/09).

Conceptual Design

- 5 kW PV system
- Original concept expanded to include two different PV technologies in otherwise identical circumstances
- PV systems integrated with covered parking structure
- Developed equipment SOW/RFP/proposal evaluation
- Selection: Texas Solar Power
- Design Charrette
 - Site visit
 - Project goals/constraints
 - Design requirements
 - Installation schedule

Design Documentation

- Documents provided by Fort Hood
 - Computer-Aided Design (CAD) files of existing site plan
 - Special Project Procedures (pre-submittal through closeout)
 - Geotechnical investigation
- Required submittals
 - Project plan
 - Design plans
 - Equipment specifications
 - Warranty information
 - Operating and Maintenance Requirements

Final Design Package

- System warranty information
- Equipment operation instructions
- Electricity production analysis
- Equipment specifications
- Design plans

System Components

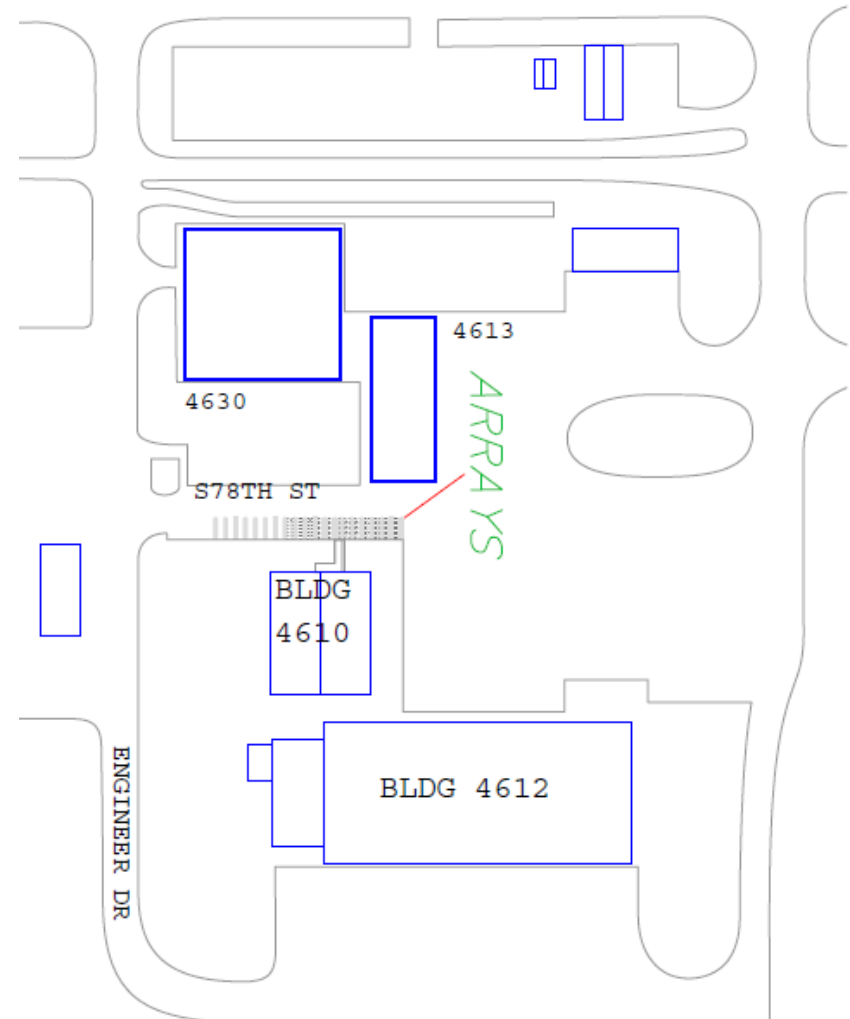
- SolarWorld SW175 Mono Modules: Monocrystalline PV panels
- Energy Photovoltaics, EPV-42 Solar Modules: Thin film PV panels
- OutBack Flexware PV Advanced Photovoltaic Combiner: Direct Current (DC) Combiner boxes
- DC Disconnect: To disconnect the PV panels from the inverter
- Alternate Current (AC) Disconnect: To disconnect the inverter from the utility grid (or building electrical supply)
- SMA Sunny Boy 5000 Inverter: To convert the DC power generated by the PV panels in AC power to be used by Fort Hood
- Lonworks Network Metering System: To connect the PV electrical generating system with the existing Fort Hood network metering system

Interconnection

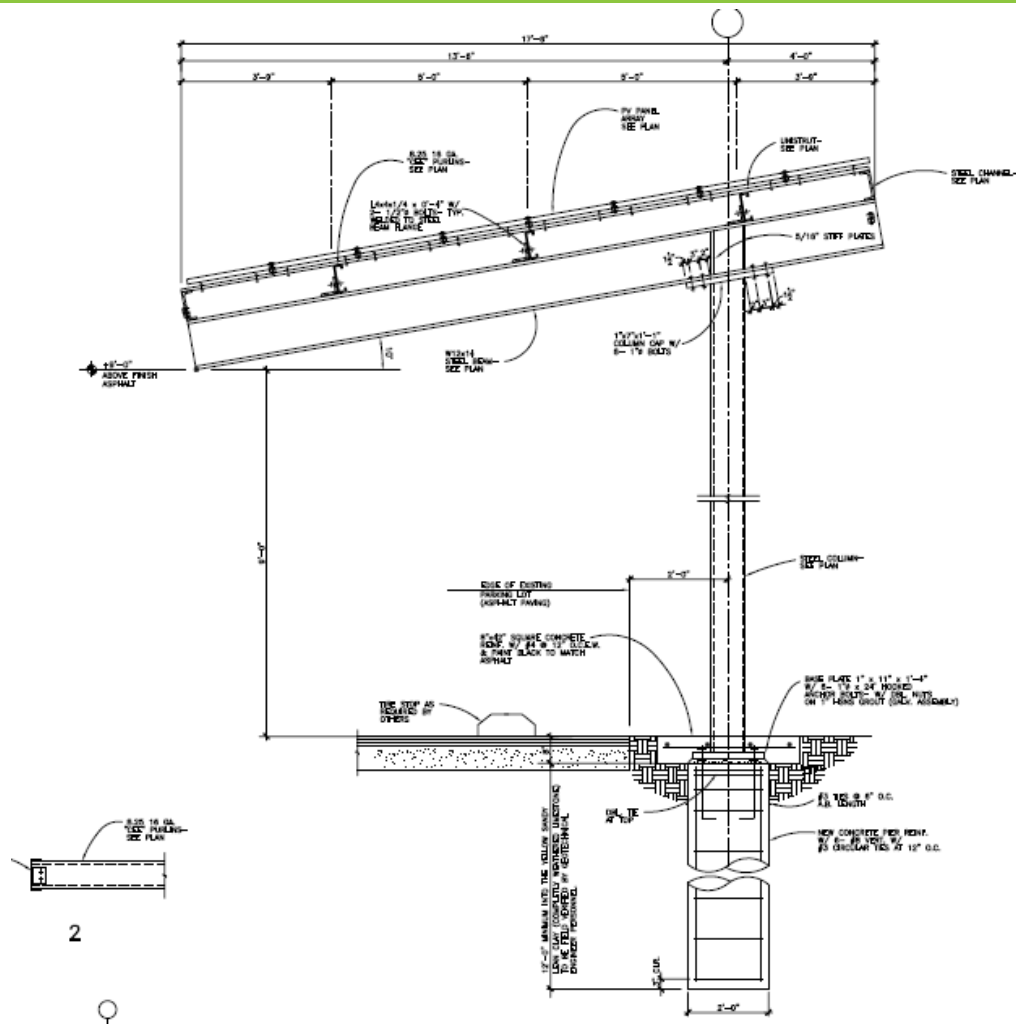
- Utility: Oncor Electric Delivery Company
- Application required for:
 - Interconnection
 - Parallel Operation of Distributed Generation with the Utility System
- Metering: compatible with Fort Hood base-wide system

Design Plans

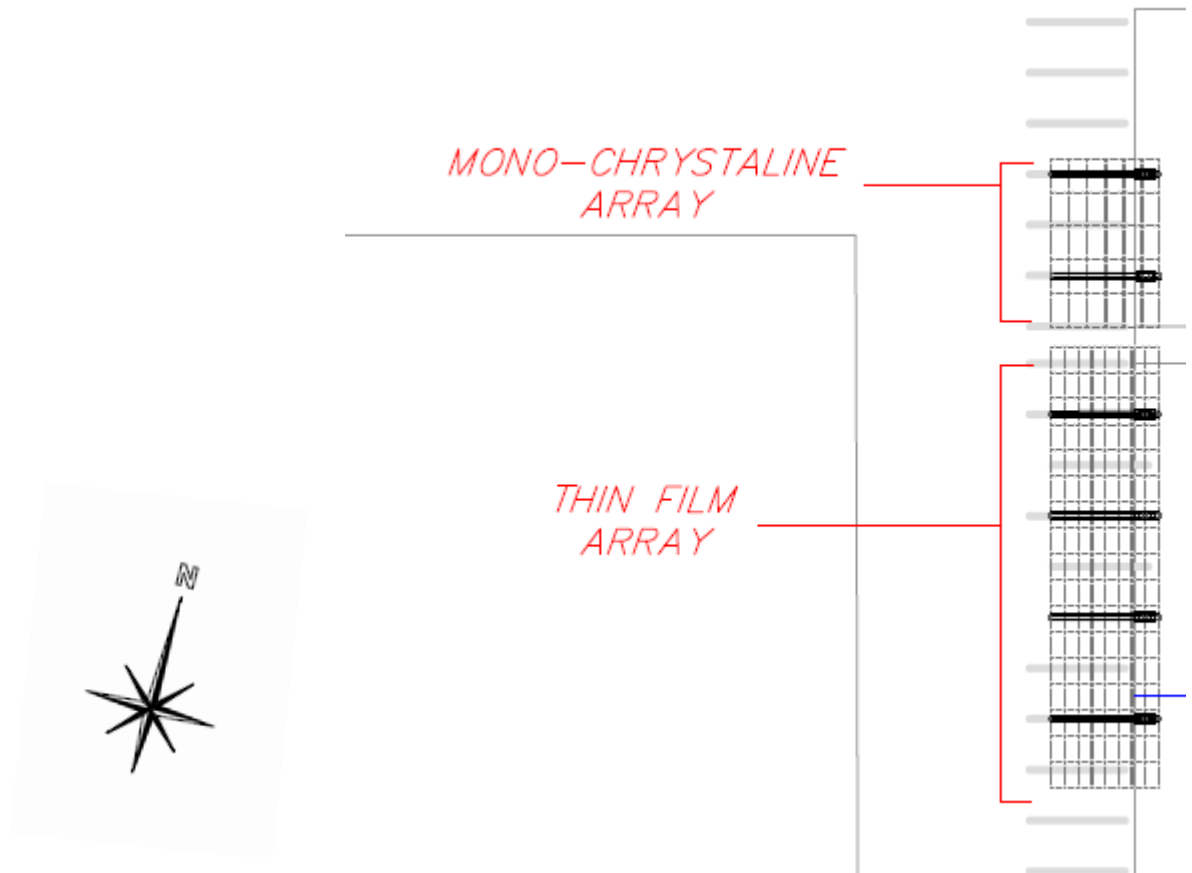
- Site
- Foundation
- Roof framing
- Construction
- Electrical



Side View



PV Layout



Construction Photos - Drilling



Construction Photos - Carport



Construction Photos



Construction Photos



Construction Photos - underneath



Construction Photos - Topview



Construction Photos – Entire view



Next Steps

- Conduct PV demonstration
- Collect monitoring data
- Analyze results
- Technology transfer report

Silicon Crystalline vs. Thin Film PV

- Demonstration will capture the following:
 - Installation issues
 - Hourly power generation
 - Peak power generation
 - Total power generation
 - Efficiency
 - Degradation
 - Maintenance requirements
 - Cost comparison (procurement, maintenance, output)



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